PHRENICOTOMY AND THORACOPLASTY*

IN THE TREATMENT OF MULTIPLE SUPPURATIVE BRONCHIECTASIS

By A. CYRIL CALLISTER, M. D.
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DISCUSSION *by Leo Eloesser, M. D., San Francisco; H. E. Schiffbauer, M. D., Los Angeles; William C. Voorsanger, M. D., San Francisco.*

UP to the time of the development of surgery in the treatment of suppurative bronchiectasis, the greater number of these cases were doomed to a slow death by fetid sepsis; were helped little, if any, by the administration of drugs; were frequently looked upon as tuberculous; were incapacitated for work and shunned by everyone because of the distressing foulness of their expectoration.

That multiple suppurative bronchiectasis of the more severe type is unilateral in the majority of cases is indeed fortunate, as an opportunity for surgical relief is thereby made possible. The medical man has usually used postural drainage in the treatment of the patient before he is referred to the surgeon, and the pulmonary surgeon should not overlook the importance of this treatment in building up the patient to withstand the severe and shocking surgery necessary in those cases in which surgical intervention is indicated.

TREATMENT OF ACUTE CASES

Cases of multiple suppurative bronchiectasis fall, so far as treatment is concerned, into two groups—the acute and the chronic. Perhaps all acute cases should at first be treated by bronchoscopy; certainly before operation every case should have a diagnostic bronchoscopic examination. This will reveal any obstruction that exists, any foreign body located can be removed, and in the acute cases this removal followed by bronchoscopic aspiration will usually be all the treatment required. Tissue found obstructing a primary or secondary bronchus, which on removal and microscopic examination proves to be carcinomatous, precludes any further surgical measures. Also it is vitally important in these cases to visualize the affected bronchial tract by the injection of lipiodol and subsequent x-ray, and in a number of cases the injection of the lipiodol or the insufflation of barium subcarbonate into this affected bronchial tract cannot be accomplished until obstructing secretion has been aspirated by the bronchoscope. It is also a much better and more scientific procedure to inject the lipiodol under direct vision into the bronchi and lung tissue directly affected and get a concentration of the drug where the trouble is, than to depend on the mere trickling of the material down the trachea and the subsequent diluted spread of the material throughout the entire bronchial tract and lungs. These patients should be x-rayed in a few moments after the injection and instructed not to cough and so dislodge the injected lipiodol or the subsequent visualization will be unsatisfactory.

In a certain number of the acute cases, even after the foreign body has been removed and repeated bronchoscopic aspiration has been done, the condition of cough, septic temperature, and production of considerable foul sputum will continue. When that time arrives, bronchoscopic treatment should be discontinued and surgery of a more radical nature resorted to. It is to one of those methods of surgical treatment that I ask your consideration, together with the report of a case so treated.

Lilienthal (text page 93)[1] has aptly pointed out that in the term suppurative bronchiectasis the name of the condition is taken only from the more apparent part of the process, that it is in reality often accompanied by a parenchymatous suppuration, and hence is associated in many cases with multiple lung abscesses which drain into the suppurating dilated bronchi with here and there an occasional obstruction. From a surgical point of view it may then be placed under the group as multiple pulmonary abscesses draining into bronchi.

There are numerous causes of suppurative bronchiectasis, the most common of which are: (1) the aspiration of foreign bodies either originally septic or resulting in a septic or suppurative bronchopneumonia; (2) septic emboli, following tonsillectomy, which strike the lungs through the jugular circulation. If a patient survives this septic bronchopneumonia the chronic bronchiectatic condition will usually ensue. Other causes are (3) chronic nasal sinusitis, (4) carcinoma of the primary bronchi, (5) embolism following any operation, and (6) pneumonia.

If one studies carefully the pathology of this form of bronchiectasis he will find that in the chronic cases morbid changes have taken place in the walls of these bronchi in the loss of elastic tissue, in induration, in round-cell infiltration with granulation tissue formation and often calcification. This will account for the almost uniformly poor results which follow medical treatment. And since many cases which involve the lower lobe have firm adhesions to the diaphragm, artificial pneumothorax will be of no avail in securing a beneficial compression of the lung. The deplorable part of the situation is that in the majority of cases the patient should have been brought to the surgeon much earlier for treatment than he usually is, and not as a last resort. When seen by the surgeon the patient is usually anemic, septic, has a myocarditis, a marked clubbing of the fingers, is underweight, poorly nourished, expectorating large quantities of fetid material, has probable numerous amyloid changes in his liver, spleen and other important organs, and last, but not least, has completely lost his morale. I cannot too strongly emphasize that if these patients are to receive surgical benefit, they be referred to the chest surgeon early in the course of their disease. The surgery necessary involves consider-

* Read before the Salt Lake County Medical Society, October 24, 1927.

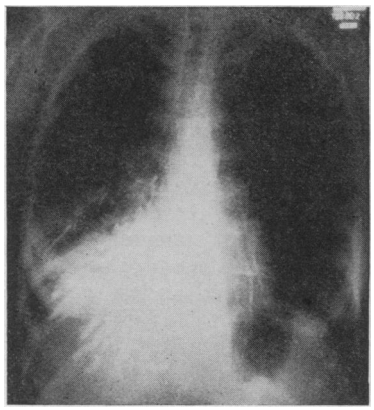

Fig. 1.—Anteroposterior view of chest with injection of bronchiectatic area with lipiodol under direct vision with the bronchoscope.

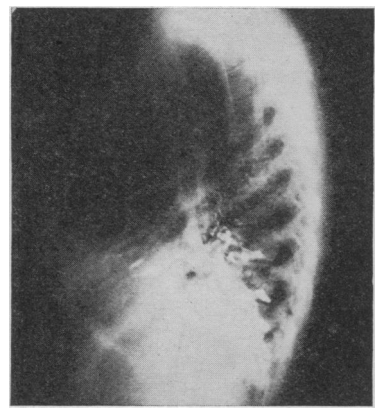

Fig. 2.—Lateral view of same chest with lipiodol injection done with bronchoscope.

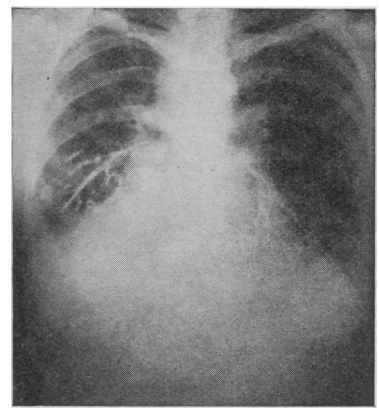

Fig. 3.—Anteroposterior view of chest with injection of bronchiectatic area with lipiodol, using the indirect or gravity method.

able risk to the patient, which risk is only heightened by a lowered physical resistance.

The use of lipiodol to outline the extent of involvement of the diseased area, combined with the x-ray, has proved so valuable a diagnostic aid that to attempt either to diagnose or to treat without their help is absolutely unjustifiable.

The lung surgeon of tomorrow must be a trained bronchoscopist in order properly to treat acute cases, and to decide which chronic conditions are operable and which inoperable.

TREATMENT OF CHRONIC CASES

The surgical procedure in the chronic case depends entirely upon the location and the extent of involvement of the lung. In small areas well localized and capable of approach through the chest wall, the treatment is the same that one would use in approaching an abscess in the locality—a two-stage or one-stage operation, depending entirely upon the presence or absence of walling off adhesions over the area. The involved area should be treated with thorough cauterization followed by packing. Subsequent steps may have to be taken to close the resulting bronchial fistulae, but a little delay on the part of the surgeon is often of more value than premature surgery, as many of these bronchial fistulae will close spontaneously if given sufficient time. The chest surgeon, unlike the abdominal surgeon, does not see his wounds heal in the self-appointed time of ten to fourteen days; he is more likely to do almost daily dressings for ten or fourteen weeks before wounds finally heal in septic chest cases.

Lobectomy.—Where the amount of sputum is large an entire lobe or even two-thirds of a lung is often involved. Obviously drainage of this large mass of lung tissue through the chest wall is impracticable. One of two methods of attack may be selected, first the removal of the septic lung tissue, and second, extrapleural compression. The cautery method of Graham is by far the safer method for removal of lung tissue, as the surgeon can stop whenever the patient's condition calls for cessation of the operation. The surgeon can resume the operation when the patient's condition permits further work, whether it is the next day, the next week, or the next month. The patient, during the waiting interval, will have been receiving beneficial drainage. This is not true when the resection and suture method of lobectomy is used, as hemorrhage must be con-

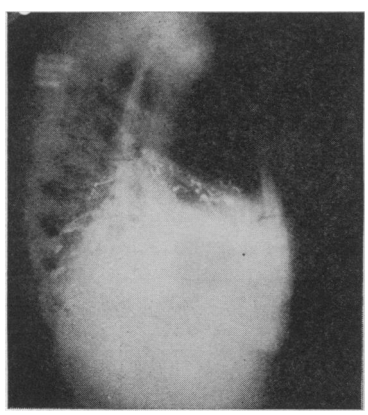

Fig. 4.—Lateral view of chest injected with lipiodol by the gravity method.

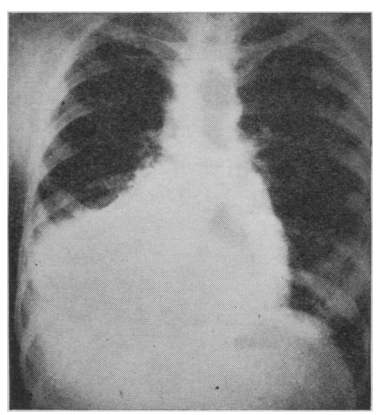

Fig. 5.—Anteroposterior view of the chest following extirpation of the right phrenic nerve showing the rise of the diaphragm and the diminishing in the size of the chest cavity following this operation.

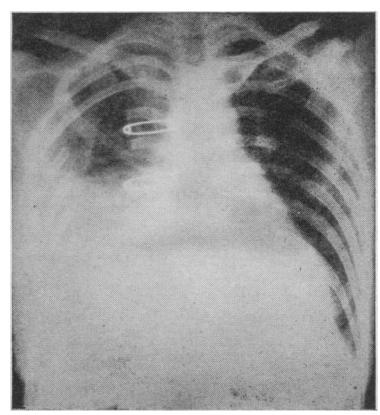

Fig. 6.—Anteroposterior view of the chest following posterior section of the fifth to the eleventh rib, inclusive. It will be noted that the upper four ribs, which have not yet been resected tend to prevent collapse of the chest cavity on that side.

trolled before the surgeon can stop, and patients may be subjected to too great shock. Lobectomy by the cautery method of Graham causes comparatively little hemorrhage, and the shock is small considering the surgery that is done.

Thoracoplasty.—The second method of treating these cases, namely by external compression with massive collapse of the lung in three stages, is much safer.

This method consists first of phrenic nerve extirpation followed by a two-stage extrapleural posterior thoracoplasty. As Alexander [2] has so justly emphasized, the diaphragm on the affected side must be put at complete rest preceding extrapleural thoracoplasty in order to avoid that most dangerous complication of this operation, namely, aspiration pneumonia. The operation used is the Felix radical phrenicotomy, sometimes called phrenicus exeresis, which consists of drawing the phrenic nerve out of the chest from a depth beyond the place where the accessory phrenic nerves usually join the main trunk. This point is about seven centimeters below the first rib or twelve centimeters from the point where the main

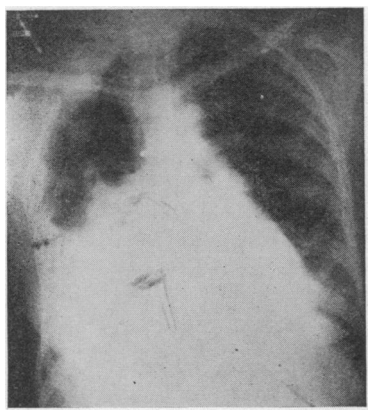

Fig. 7.—Anteroposterior view of the chest following the complete operation and taken shortly before the patient left the hospital.

phrenic nerve is conveniently sectioned on the anterior scalenus muscle in the neck. It is important, because of these accessory phrenic nerves, that the nerve be extirpated and not merely sectioned, as in the latter case a paralysis of the diaphragm on that side which the surgeon is striving for will not be complete. This operation is done entirely under local anesthesia. In the paravertebral thoracoplasty the anesthesia is again local, and is done by the Wilms-Sauerbruch technique, which consists of both paravertebral block and interosseous infiltration. It is preferable to remove the sections of the lower five or six ribs in the first stage and complete the operation in the second stage. The first rib is particularly difficult to section as it lies deep, nearer the front than the back of the chest, is grooved by the subclavian artery, and presents its posterior inferior edge to the operator rather than the flat posterior surface as the other ribs do. I have found Lilienthal's guillotine of great help in removing this first rib. The general course of approach follows the outer edge of the erector spinae muscles, but these must be sectioned transversely over the neck of each rib in order to cut the rib as near the vertebral column as possible. The muscles between the scapulae and the vertebral column are sectioned in resecting the ribs in this region and afterward carefully repaired to produce as little disability of the shoulder in this region as possible.

The operative shock is considerable. An anemic patient should be transfused beforehand, and a donor should be ready immediately after the operation, as transfusion will almost surely be necessary because of the large blood loss and shock involved in this operation. Rapid teamwork is necessary. Sauerbruch has shown in his statistics that, in any of these operations that consume over an hour, the patient almost certainly dies. Oxygen and intravenous glucose and saline are usually necessary supplements to the operation.

CASE REPORT

Mrs. E. M., age nineteen, admitted to the L. D. S. Hospital, October 7, 1926.

Two years ago the patient was operated on at a local hospital for removal of tonsils and adenoids, and a week later developed what was diagnosed as a bronchopneumonia. She was very ill with this condition for about three weeks, but gradually improved so that she was able to leave her bed. She had developed an almost continuous cough with the production of a copious thick, fetid sputum, the amount reaching as much as 8 to 10 ounces in twenty-four hours. Her weight before the tonsillectomy had been 129 pounds, and at the time of examination was but eighty-three pounds. She had chills every afternoon, followed by fever which reached 101 to 102 degrees each afternoon. She was short of breath, pallid, and barely able to walk for a small portion of the day. She had been under observation and treated by several doctors since the onset of her illness, was gradually growing worse, and was referred to me with a diagnosis of lung abscess, for decision as to whether she could be helped by surgery.

Her past history shows measles and mumps in childhood. She is married, but has recently been deserted by her husband because of her physical condition.

Physical Examination.—A poorly nourished and anemic young woman with clubbed-fingers and a persistent cough. Her temperature on admission was 102.8, her pulse 100, and her respirations 30.

Pupils equal and react to light and accommodation. Nose not obstructed. Throat negative. The teeth in fairly good condition. Neck shows no enlarged glands, nor is there any abnormal enlargement of the thyroid.

Heart dullness about normal in size and position. Sounds regular and of fair quality, no murmurs, nor thrills. Apex impulse in the fifth left interspace and about four and one-half inches from the midsternal line. The chest on percussion shows dullness of the entire right side up to the level of the fourth interspace posteriorly and slightly higher anteriorly. The breath sounds were rather distant and vary considerably over different places listened to. In some spots moist râles could be heard. The fremitus also varied considerably. A few moist, coarse bronchial râles could be heard over the left chest, but there was no abnormal dullness, and the breath sounds were of fairly normal quality.

Abdomen soft, slightly tympanitic. No masses, spasm nor tenderness. The liver edge and the spleen were not palpable. Pelvic examination showed no ab-

normalities. With the exception of clubbing of the fingers the extremities were negative.

Urine: alkaline, sp. gr. 1010; faint trace albumin; many pus cells; no casts.

The patient was put to bed on postural drainage treatment and the chest x-rayed. The plate showed the entire lower half of the right chest opaque with no evidence of a fluid level. On the third day a bronchoscopic injection of lipiodol was done and the chest again x-rayed. Figure 1 shows the anterior-posterior, and Figure 2 the lateral views of the chest, showing bronchoscopic injection of the lipiodol. They show numerous dilated bronchi ending in clubbed endings of terminal abscesses. Figures 3 and 4 show the anterior-posterior and lateral sections of the chest with lipiodol introduced by the indirect method, dropping it down the trachea. The advantage in visualization to be secured by bronchoscopic injection of the lipiodol over the indirect or gravity method is readily seen.

It was decided because of her wide septic swing in temperature to continue postural drainage and general supportive measures to improve her general condition before operation. She was accordingly discharged to her home on October 13, 1926.

Patient readmitted to the hospital on November 23, 1926. Her condition was slightly improved, but her cough was very persistent and she was running a septic temperature. On November 27, under local anesthesia one-half per cent novocain, a radical extirpation of the phrenic nerve was done (Felix operation). This was followed by immediate epigastric pain and tachycardia which was not persistent. Her chief complaint was of considerable pain in her right shoulder. The coughing decreased and, although postural drainage was continued, the amount of twenty-four-hour sputum was considerably lessened. Figure 5 shows the diminution in size of the chest cavity as a result of the paralysis of the right side of the diaphragm, due to the right phrenic nerve resection. The sputum had been persistently negative for tuberculosis on fifteen examinations, and at this time showed a large amount of pus, streptococci, staphylococci, and degenerated epithelial cells. The wound healed by first intention and she was discharged home on December 10 to gain what benefit she could from this preliminary operation.

On January 18, 1927, she was readmitted, running a slight afternoon temperature of one or two degrees, and the twenty-four-hour amount of sputum had diminished to one and one-half ounces. The cough had become more infrequent and had permitted the patient to sleep much better at night. Her white blood count was 15,780, her hemoglobin 60 per cent, and her red count 3,900,000. She was typed for transfusion. On February 3, under the Wilms-Sauerbruch technique with local anesthesia, sections of the fifth to the eleventh ribs inclusive were removed. The shock reaction was rather marked, and the patient was transfused with 700 cc. of blood immediately following operation. Her blood pressure ranged from a systolic of 86 to 96 for forty-eight hours following the operation. Oxygen was administered intermittently during this period together with intravenous glucose and saline. The patient gradually recovered and the wound healed kindly. Figure 6 shows the x-ray of the chest cavity following the partial resection of the lower six ribs. Upon examination of this x-ray one can readily see how the upper ribs, which have not been resected, prevent collapse of the chest cavity. On March 10 the patient's condition was such that the second stage of the operation was done under local anesthesia, the upper four ribs being removed. The reaction was not so marked on this occasion, but on the second day after the operation the patient had a sudden chill followed by a pain in the left chest, pulse of 140 and respirations of 44. A coarse, pleural friction rub developed in the left chest anteriorly, and the patient's condition was precarious. Oxygen was given almost continuously to relieve the cyanosis, and heat applied to the left chest. The temperature dropped by crisis in forty-eight hours from 104 to normal in eight hours. It then developed a slight septic swing, but the patient's condition was very much improved. The temperature continued to have a septic swing until April 2, when 300 cc. of green, turbid fluid was removed by puncture. Her condition had continued to improve to such an extent that she was permitted to go home ten days later to continue her convalescence. Figure 7 shows the condition of the right chest cavity following the phrenic nerve extirpation and resection posteriorly of the entire eleven ribs. If this is compared with Figure 1 it can readily be seen that a marked decrease in the volume of the chest cavity has been accomplished which, by actual measurement, is diminished to one-eighth its original size.

Patient has been seen at two-week intervals at the office. A summary of her condition shows that she has gained twenty-nine pounds, has a normal temperature, sleeps all night without coughing, coughs only occasionally during the day, is doing her own work, and is raising less than one-half ounce of sputum in twenty-four hours. The sputum has lost much of its offensive odor.

On September 11 this patient was readmitted to the hospital with a gangrenous appendix, which was removed under local anesthesia and from which she made a satisfactory convalescence.

CONCLUSION

1. Chronic suppurative bronchiectasis should be treated by surgical measures. This is particularly true when repeated bronchoscopic aspirations do not afford permanent relief.

2. Extensive lesions of this sort can be treated best by extrapleural compression. This treatment is probably safer when it consists of phrenic nerve extirpation, followed by posterior thoracoplasty which should be complete for the side affected.

706 Medical Arts Building.

REFERENCES

1. Lilienthal: Thoracic Surgery.
2. Alexander: Surgery of Pulmonary Tuberculosis.

DISCUSSION

LEO ELOESSER, M. D. (490 Post Street, San Francisco).—To fully discuss Doctor Callister's interesting presentation would take more space than the journal would be ready to allot me; so many of his statements invite discussion in spite of the uncommonly good result of his treatment. Abscess and bronchiectasis should, I think, be kept clearly apart, although I will concede that the chronic indurative pneumonias that follow old abscesses may occasionally carry bronchiectatic dilatations in their train, as Doctor Callister's patient evidently did. Bronchiectasis, however, rarely causes extensive parenchymatous suppurations; indeed it is striking how well the suppuration is confined to the bronchiectatic pouches, even when the suppuration is of very long standing.

Upper respiratory infection has been the most frequent cause of bronchiectasis in patients with whom I have had to deal.

This, however, in passing; I have been much disappointed in the results of external compression for bronchiectasis. The sputum has been diminished, it is true, but it has never disappeared; the operation is not without risk, as the stormy convalescence and alarming postoperative course of Doctor Callister's patient shows. I imagine that in less energetic hands and with less careful postoperative treatment she would have succumbed. Opening the suppurating pouches with the galvanocautery after the method of Graham has, when all the pouches are really open,

been more satisfactory and has caused entire cessation of cough and sputum.

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H. E. SCHIFFBAUER, M. D. (520 West Seventh Street, Los Angeles).—Doctor Callister has given a very terse and excellent presentation of the treatment of suppurative bronchiectasis. I wish to endorse this method.

It is this type of paper which will help to educate the internist in the value of having his bronchiectatic patient under the supervision of a surgeon. The chest surgeon can assist the internist in the outline of the nonoperative treatment and can select the proper time for surgical intervention.

The suggestion that the chest surgeon be a bronchoscopist is a good one, as it will enable him better to visualize the lung pathology with which he is dealing.

Repeated bronchoscopy with aspiration and the injection of lipiodol is a decided advantage to the patient in preparing him for operation.

The operation on the phrenic nerve might be more properly termed phrenic neurectomy; as phrenicotomy implies only a severing of the phrenic nerve, whereas in the case reported a neurectomy was performed. In small bronchiectatic cavities at the base a phrenic neurectomy is all that may be required. I have a patient operated upon fourteen months ago in whom the expectoration is so slight and without any paroxysm of coughing, and whose general condition is so good, that further surgery has been refused.

It is always advisable to perform a phrenic neurectomy before other major operations; it has many advantages and no serious disadvantages.

As to paravertebral anesthesia, I have found it to be dangerous and unnecessary. Undoubtedly some of the serious postoperative reactions are due to this method, and several deaths have been reported from its use. The intercostal block anesthesia is a satisfactory anesthesia, so far as pain is concerned. For a psychic effect, which is necessary in many patients, I use the minimum amount of ethylene sufficient to abolish consciousness.

The Wilms-Sauerbruch extrapleural thoracoplasty is the operation of choice in certain types of early chronic bronchiectasis, the Graham cautery method and lobectomy being reserved for the more extensive involvements.

With the proper application of the surgical procedures mentioned, many patients suffering from chronic bronchiectasis can be cured and returned to their former mode of living.

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WILLIAM C. VOORSANGER, M. D. (490 Post Street, San Francisco).—Doctor Callister has presented a brilliant exposition of his subject with a brilliant result in a case of suppurative bronchiectasis treated by thoracoplasty. Naturally I can only discuss the medical aspect of the subject which does not advocate external compression as a cure for bronchiectasis. In my hands artificial pneumothorax has never caused a permanent cessation of cough or sputum in bronchiectasis.

Hedblom, who at first strongly advocated thoracoplasty in bronchiectasis has become more conservative, due to recurrences; and Lambert, with a vast experience in this work, does not believe the operation is permanently curative. The best surgical results have been obtained by Graham's gradual cauterization of abscessed cavities and gangrenous pouches. It would be interesting to have Doctor Callister report on his patient in another year and let us know if symptoms have recurred.

Bronchiectasis is a multilocular disseminated disease, and collapsing one lung does not prevent the disease recurring in the other lung. I am firmly of the belief that the cure of bronchiectasis lies in its early recognition and early elimination of its cause, which in a large number of patients is due to infected sinuses. In a recent publication on "Undiagnosed Cough" we stressed the point that there is a 38 per cent group which becomes either bronchiectatic or tuberculous. The potentially bronchiectatic group will often yield successfully to an autogenous vaccine. Even when the bronchiectasis becomes fairly progressive, bronchoscopy, postural drainage, and the use of an autogenous vaccine should be tried before resorting to surgical intervention.

In spite of Doctor Callister's splendid result, I cannot agree with his conclusion that even extensive bronchiectatic lesions should be generally treated by "extrapleural compression."

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DOCTOR CALLISTER (closing).—I wish to thank Doctors Eloesser, Schiffbauer, and Voorsanger for their kindly discussion of this paper. Although there is much debatable ground covered in this method of treatment, it is applicable in a considerable number of cases, and where the usual medical methods are not gaining ground in a patient's condition this treatment will in suitable cases give definite improvement and perhaps an occasional cure.

Graham's method of cauterization is preferable when the process is not extensive, but to use it in a widespread unilateral process would virtually amount to lobectomy, which carries a much higher mortality than extrapleural thoracoplasty.

Paravertebral anesthesia when accomplished lessens the amount of novocain injected and shortens considerably the duration of the operation by doing away with considerable of the interosseous block, a time-consuming procedure.

HYPERPYREXIA*

REPORT OF AN UNUSUAL CASE WITH RECOVERY

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DISCUSSION *by Chauncey Leake, Ph. D., San Francisco; Newton Evans, M. D., Los Angeles.*

AUTHENTIC reports of unusually high temperatures in man seldom occur in the literature. Many of them, partly because of the human interest appeal to the laity, are gross exaggerations which occupy newspaper space, cause comment, and are forgotten without investigation. An exception to this, however, was the Escanaba case which Woodyatt and Fishbein investigated in 1923,[1] and proved to be a hoax perpetrated by an hysterical woman. Moreover, the majority of the few incidents of hyperpyrexia reported, are temperatures just preceding death which is a frequent physiological observation.

MECHANISM OF TEMPERATURE REGULATION

The mechanism of temperature regulation in the human body has long been a subject of research, and the source of many hypotheses. Such regulation has been accounted for on two main theories: one, that it is due to changes in heat production, the other "held by a minority, that it is kept so by changes in heat dissipation under the varying conditions of external temperature." [2] Ott feels that the corpus striatum and tuber cinereum play a prominent part in the production of fever. Burton-Opitz has stated that in his

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